Development of a hierarchical integrated enterprise management system with the use of the grai-gim and cimosa methodologies

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Abstract:

The issue of development of a hierarchical integrated system of production system management is considered. The main principles of enterprise management are defined. The interconnection between major management functions is represented in the form of the management cycle within the frame of the generalized system of enterprise management. The functional and processing approaches in enterprise management are analyzed and their advantages and disadvantages are defined. Special features of building of a hierarchical integrated management system (IMS) are identified. The feasibility of GRAI-GIM and CIMOSA methodologies using for building a dynamic organizational management structure within the IMS is investigated. The generalized model of the production system management, comprising a physical system, a production management system, and an integrated information system is introduced. The scheme of development of an integrated enterprise model according to the GIM - CIMOSA methodology is suggested.

Key words:

Enterprise management, hierarchical integrated management system, GRAI-GIM and CIMOSA methodologies, dynamic organizational structure.

ACM Computing Classification System:

User models, User studies, Usability testing, Heuristic evaluations, Walkthrough evaluations, Laboratory experiment.

Introduction

A modern enterprise represents an independent organizationally isolated national economy production sphere business unit, producing and selling goods, performing industrial works. One of the ways to solve the task of raising business efficiency is implementation of new technologies, meant to integrate isolated subsystems, uniting them

into an integrated system. Reaching this goal is possible only after building an effective enterprise management system.

Management's main task is providing growth of production efficiency on the basis of continuous enhancement of the technical level, management forms and methods, increasing productivity of the most important enterprise revenues gain and growth conditions [1-4].

1. Principles of enterprise management

Enterprise management is based on the principles, meant by governing codes and guidelines, taken as a basis for management problems solving. The most important principles of production management organization are:

1) objective compatibility and concentration principle;
2) continuity and reliability principle;
3) plan conformity, proportionality and dynamism principle;
4) the democratic principle of management functions distribution;
5) the management's scientific justification principle;
6) management efficiency principle;
7) the principle of personal, collective and state interests compatibility;
8) the principle of made decisions control and execution check.

The management process should be carried out on the basis of the system approach principles, as it represents the complex of many interrelated processes. Production systems management is intended to organize the personnel's activities, which allows reaching the set goals.

You have to take many decisions, performing planning, work organization, people's motivation, controlling and coordinating all the processes, taking place in the organization, in the course of management functions fulfilling. That's why management can be presented in organizational and technical systems as a sequence of functions, making up the management technological cycle. A management function means a stable harmonized assembly of operations, based on division of labor in the management system. Five main management functions are taken into consideration: prediction, organization, managerial activities, coordination (finalization) and control. At that all the functions are divided into six groups: production, finance, security, accounting, administration, safety engineering [5-8].

Along with this the following management system division criteria have been determined:

- by management essence, by virtue of which they are contained in every management task and altogether combine a closed management cycle;
- by management activity uniformity, defining the management labor differentiation (exact management functions);
- by the goal orientation uniformity (special management functions);
- by elementary managing impact forming orientation (management tasks);
- by management labor differentiation at its elementary managing work level.

The basic functions' correlation is presented in the form of a management cycle (fig. 1).

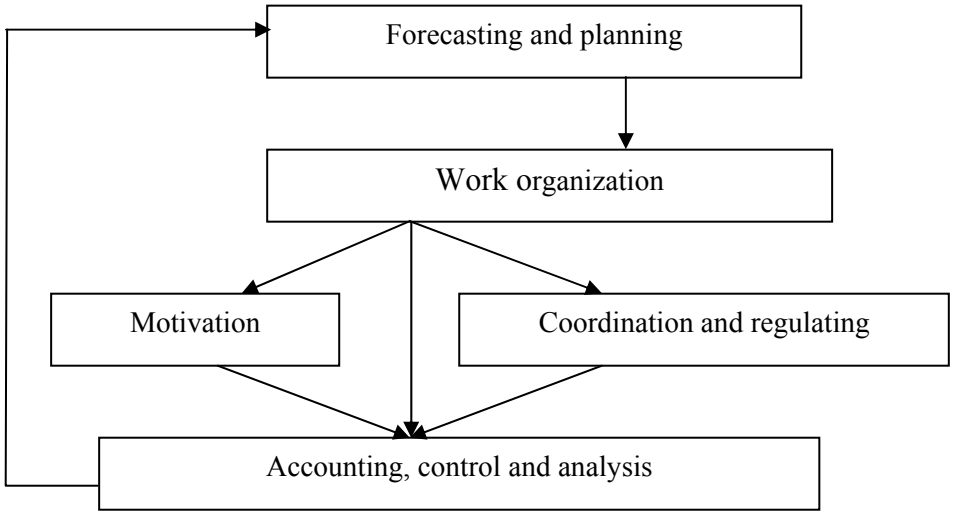

Figure 1. The management cycle, formed of general management functions

The set operation of an enterprise is provided by the management system, presenting a complex formation of processes and events, that can be perfected with different degree of detalization (fig. 2) [3, 4].

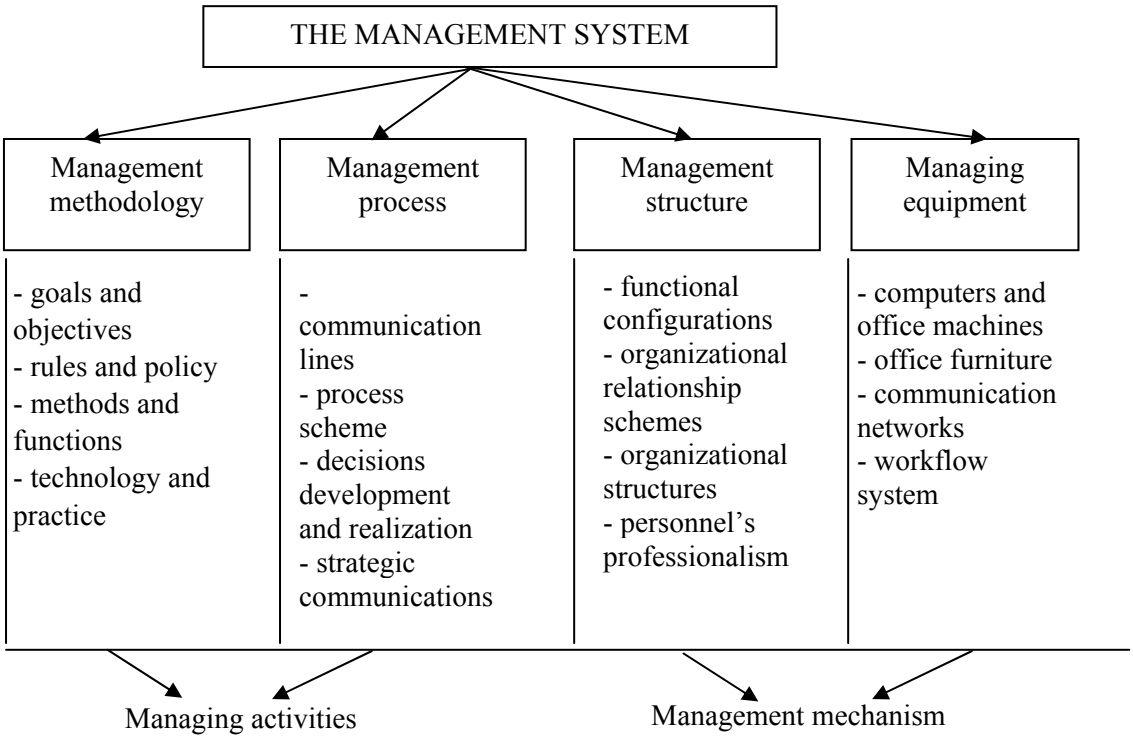

Figure 2. The generalized enterprise management system

2. Functional and processor approaches in enterprise management

Most of the existing enterprise management systems are based on the functional approach, considering an enterprise as a mechanism, possessing a set of functions. These functions are distributed among divisions between decision-makers (DMs). The enterprise's employees perform their highly-specialized duties without working to reach the enterprise's mission, as these functions may not be directed on reaching the final result. Structural subdivisions interact with each other, deal governing inputs, that take more time, than performing the work itself, which raise different disagreements between DMs [9-11].

The main disadvantages of the functional approach are the following:

- a functionally structured enterprise does not encourage employees' involvement in reaching the final result of the enterprise's activity. The employees' vision of the happening events most often doesn't go beyond the limits of their department, that's why they are not oriented on the enterprise's final targets, and especially on customers' satisfaction (with works, services);
- most of the technological business-processes of an enterprise includes lots of functions, i.e. go beyond the limits of specific departments. However, the exchange of information between different departments within functionally oriented structures is extremely complicated because of its vertical hierarchal pattern, which leads to large overhead costs, unreasonably long terms of managerial decisions making;
- big part of the time, necessary for realization of managerial impacts on production process, is spent on interactions between DMs and it's much longer than the time, necessary to realize the decision itself. This leads to great unreasonable delays in reaction to the disturbance input.

From the perspective of the processor approach an enterprise comprises of a set of processes. Business-processes follow through all departments and orientate on the enterprise's functioning final result. Every process has its own goal. You can reach high activity efficiency while managing processes if you establish strong horizontal links vertical structure of the enterprise management. The processor approach represents inner suppliers' and customers' «outcome» on a resourceful idea. In fact, real activity bringing added value, is not carried out by isolated elements of the functional hierarchy, but it penetrates the enterprise as an assembly of processes [1-4].

The processor approach allows to:

- consider such important aspects of business, as orientation on the final result of the enterprise's activity, commitment of every DM in raising efficiency of production in general and, consequently, commitment in high quality job performance;
- react to outer and inner changes more flexibly;
- optimize information exchange between functional departments;
- realize the most important idea of quality management: embedding quality control into the process instead of end product quality control.

When realizing processor approach:

- executives are given wide range of powers, increasing their role, independence and, consequently, effective output and labor satisfaction;
- managers are liberated from operational matters resolving and concentrate on strategic, system matters.

Thus, building an effective integrated enterprise management system supposes cooperation of both functional and processor approaches, realized within the framework of an object-functional enterprise management system [12-15].

3. Specific features of a hierarchical integrated management system building

Enterprise management process is considered on two levels: goods (works, services) production process and the hierarchal administrative production process management superstructure. The first level represents technologic business-processes with the enterprise resources (technical and process, material, labor, informational, financial) as an income and having end product, performed works or rendered services as an outcome. The second level of representation administrative business-processes are realized, including:

- studying of suppliers' and customers' markets;
- widening conceptualization and strategy;
- designing products and services;
- enterprise resource management;
- outer links management;
- improvements and changes management.

An enterprise's production activity in a relatively stable outer environment supposes building a system of administrative business-processes on the basis of the planned technologic business-processes, carried out at the enterprise projecting stage. However, the market's requirements to the product quality are being raised, order execution time is lowered, the output product stock list is changing, which realigns the enterprise functioning process significantly. This leads to changes in technologic business-processes and information database contents change, while changing management objects' properties changes the contents and the quality of DM functions, as well as the information interlink system.

Technologic and administrative business-processes influence:

- the structure and the contents of the information database;
- the interaction between DMs in correspondence with their functions, responsibility and rights;
- the management objects and their properties.

In its turn, changing management objects' properties influences DM functions, the contents of the database and the administrative business-processes [4, 5].

In order to provide the most rational real-time reaction of an enterprise to disturbing factors it is efficient to use an integrated management system (IMS) building methodology, aimed for the enterprise management system structuring to provide forming and effective functioning of a dynamic organizational management model. This methodology is based on the following statements (fig. 3):

1. Creation of united informational managerial decisions and governing inputs space.

2. Exception of duplicate information flows and, consequently duplicate management functions.

3. Management functions decentralization and redistribution of responsibility for the enterprise's resources while performing managerial tasks.

4. Forming regulations of the enterprise's resources creation, using and storage in the integrated database.

5. Tracking information lifetime cycle stages to perform the strategic enterprise management tasks.

6. Forming enlarged factors for the enterprise's current state evaluation, business development forecasting.

7. DMs' labor motivation for timely and high-quality managerial actions within the limits of delegated powers and the rights to use the enterprise's resources, given to them.

An important peculiarity of IMS is the dynamic projection of new informational links, changing depending on the solved managerial tasks' specific contents on the enterprise's existing organizational-production objects management functions.

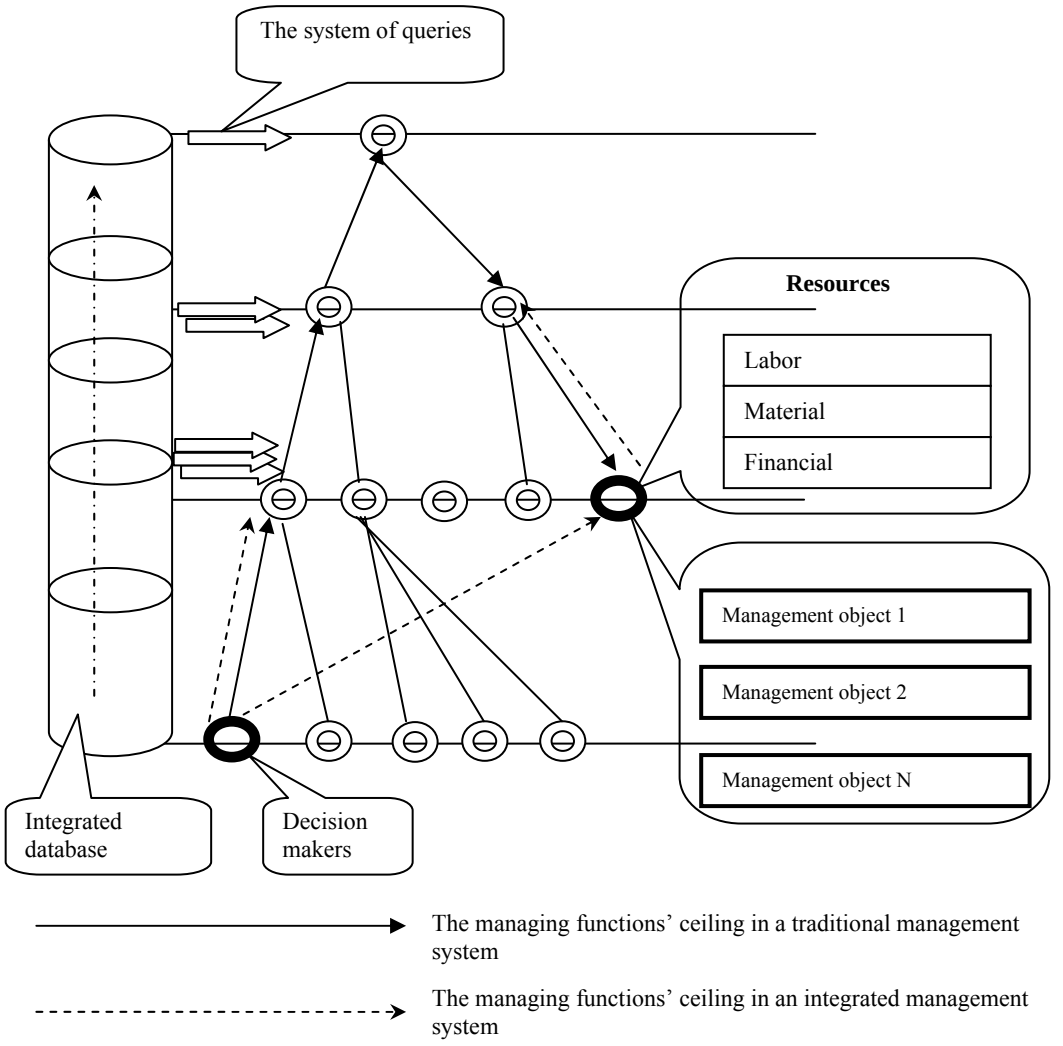

Figure 3. The integrated management formation scheme

Thus, while performing a specific managerial task the management system hierarchy stays the same, but the informational structure of the managerial decisions taking process changes. The system of distributing rights on information queries

depending on the task being solved allows to build variants of DMs' network interaction with management objects in accordance with the corresponding functions set.

That's why an IMS enables you to take effective managerial decisions not so much by means of computer network information transmission speed increase, as by means of the management system's strategic reaction to inner and outer disturbing factors [1, 10, 15].

IMS differs from the existing enterprise management systems by the following parameters:

1. Efficient functioning in the changing outer and inner environment conditions.
2. It allows to take managerial decisions in real time according to the developed enterprise business-processes regulations.
3. It provides a formalized distribution of rights, duties, responsibility and the enterprise's resources between DMs.
4. It allows to solve non-typical situations, caused by deviations from business-processes' normal course without conflicts.

4. Application of GRAI-GIM and CIMOSA methodologies for building a dynamic organizational structure of management within the framework of an integrated management system (IMS)

It is suggested to build a dynamic organizational management structure within an IMS using the GRAI-GIM and CIMOSA methodologies, which allow exploring and designing a production management system and performing the process of managerial decisions taking.

The generalized production system management model consists of the following components (fig. 4):

- a physical system,
- a production management system,
- an integrated informational system.

A management system consists of a hierarchal structure, decision making centers, containing all decision making functions on the set hierarchal level. Such an enterprise hierarchal structure makes the information system hierarchal as well.

Information from the physical system and from the environment is filtered, integrated and supplied for using to every decision making center of the hierarchal enterprise management system.

The management system, that composes decision making variants and the information system, which regulates the physical system, enable reaching the production goals. The most important property of a management system is the function of acquiring information directly from the integrated database in real time mode. The GRAI method's modularity consists in production management processes description formalization, aimed for maintaining the dialogue and information exchange between the management process participants.

GRAI-GIM contains a technological and administrative business-processes description method in the context of functions, information, decision making system and using different kinds of resources. The decision making system determines the patterns of the material and the information systems' behavior in order to transmit, process and remember the necessary information.

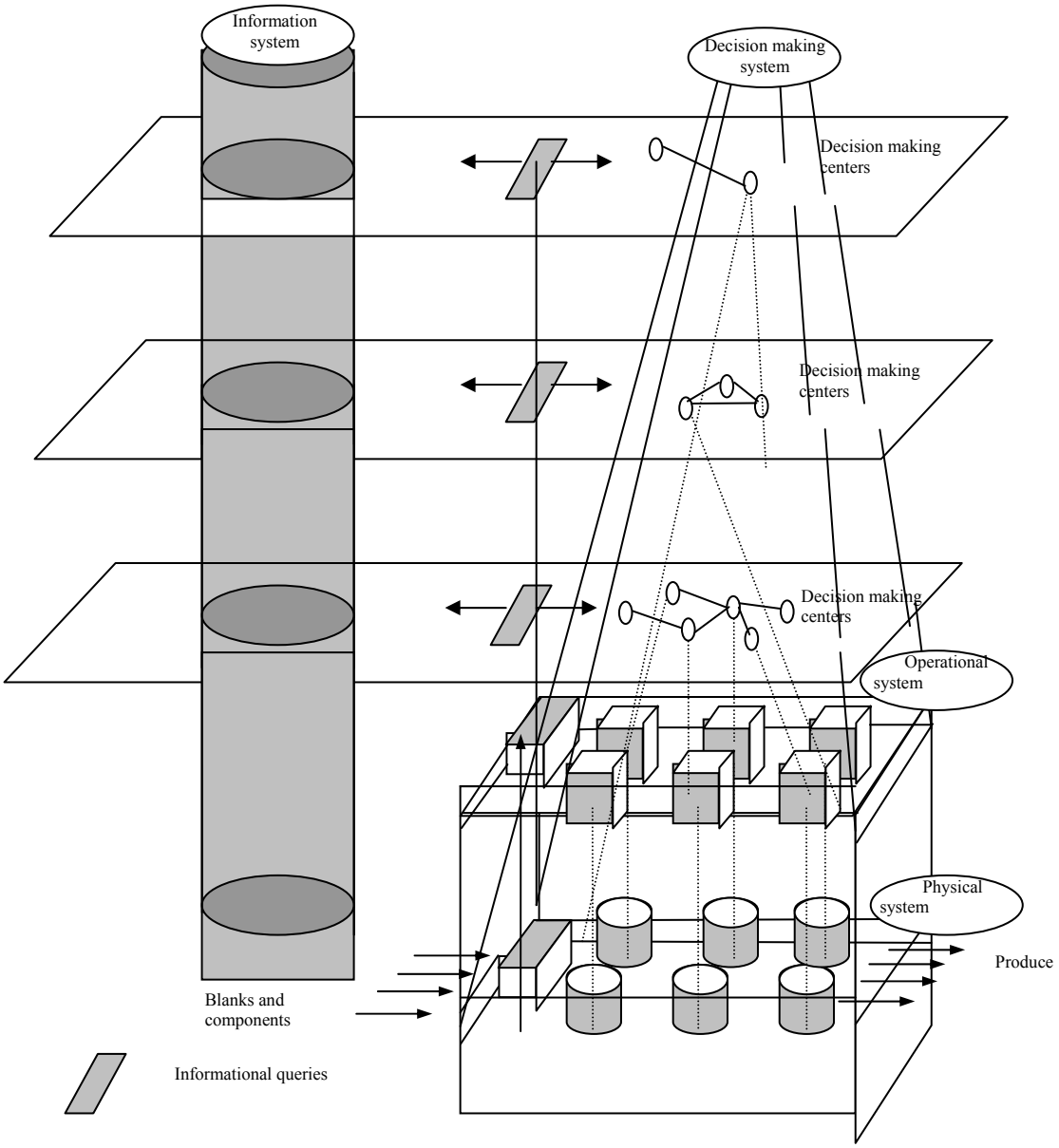

Figure 4. The production system management model

The CIMOSA methodology allows using the enterprise model for planning and strategic management. Reaching this goal is encouraged by developing of two components: the enterprise model being carried out and the integrated production infrastructure. The enterprise model is presented as a multidimensional space, the so-called CIMOSA cube (fig. 5).

The integrated enterprise model creation process is carried out by the used on three modeling levels:

- determining business requirements for the enterprise;
- transparent process optimization;
- the project's technical specifications.

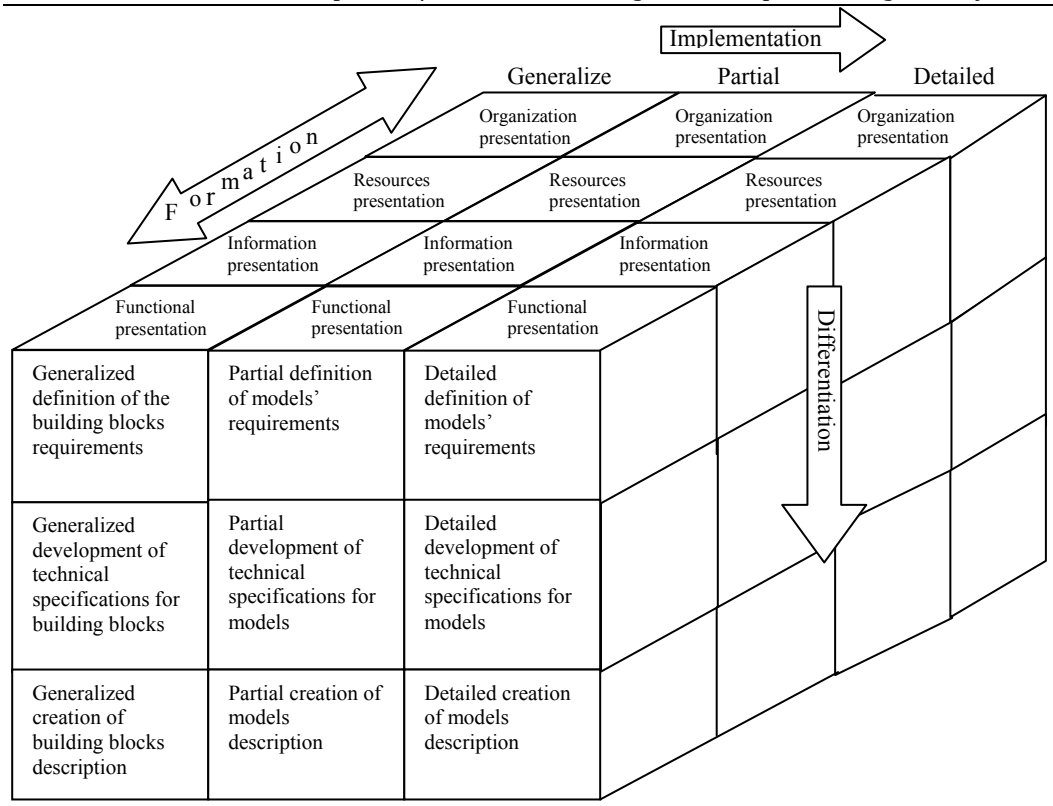

Figure 5. CIMOSA methodology presentation

During modeling process the enterprise is analyzed on every level regarding different user's presentations considering the fact that these levels may be present on all lifetime cycle stages, related to creation of any processes. Each of the levels is represented in four planes (Fig. 6.), where the following are realized:

- functional presentation (action sequences are described);
- informational presentation (functions inputs and outputs are described; data model is described);
- resources presentation (material, labor, technical and process and informational resources structure is described);
- presentation of an organization as a system of authorities and duties.

The corresponding structures are designed within the CIMOSA methodology in a way that they are mostly suitable for computer processing and provide their maximum efficiency. In order to support this requirement, two environments have been designed, in which:

- the developer, designing an integrated enterprise, formalizes enterprise models designing and performs their adaptation to working in computer enterprise management systems;
- the enterprise's operational environment formalizes checking, testing and acceptance of the following programs to the enterprise management informational managing system.

These environments have sets of formal functions, which enable to carry out integration of infrastructure and provide enterprise management system flexibility and its independence from the project's developer.

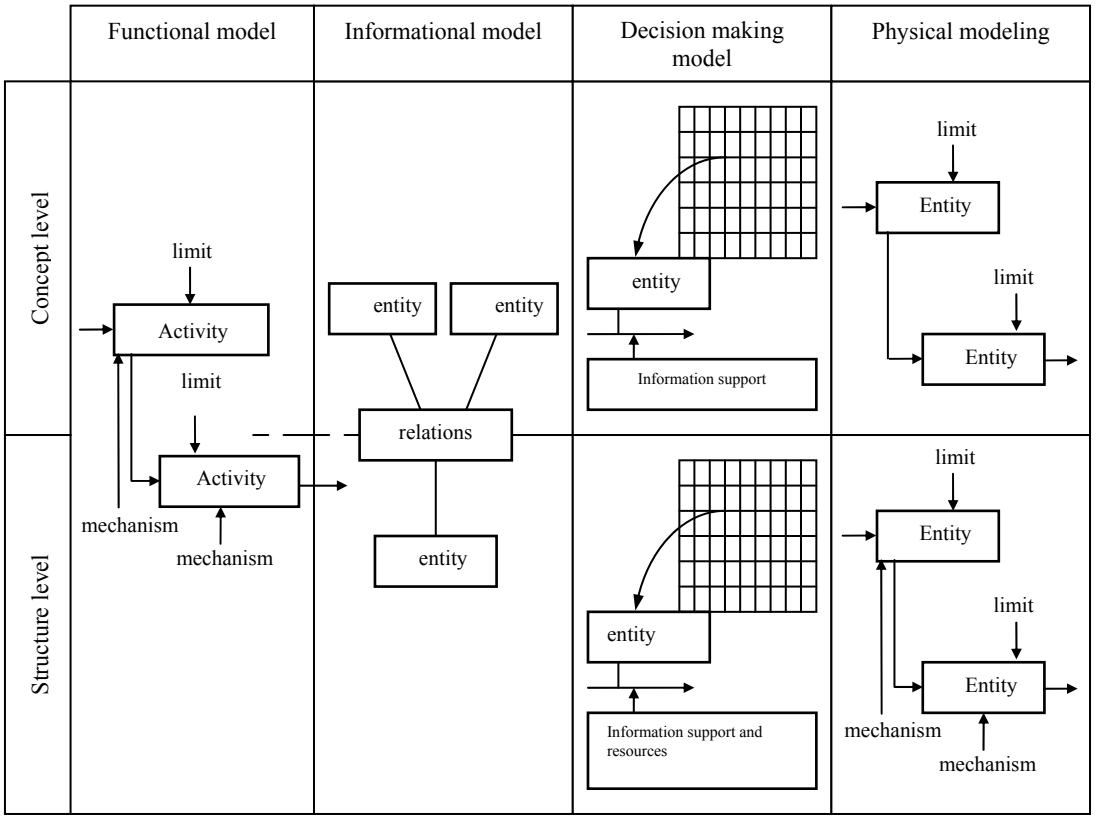

Figure 6. The integrated enterprise model designing scheme in correspondence with the GIM – CIMOSA methodology

Conclusion

Therefore, as a result of this study the analysis of organizational structures building methods development tendencies, aimed at raising the efficiency of modern enterprise business-processes management systems, has been carried out; a model of an integrated enterprise management system, notable for dynamic projection of new information links, changing depending on specific contents of the managerial tasks being solved on the existing enterprise organizational-production objects management functions, has been suggested.

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